OCR
Oxford Cambridge and RSA

CAMBRIDGE TECHNICALS LEVEL 3 (2016)

Examiners' report

APPLIED SCIENCE

Cambridge TECHNICALS

05847–05849, 05879, 05874

Unit 2 January 2020 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

You can now find the results awarded in 2018/19 for your Cambridge Technical subject area

As a centre approved to offer our Cambridge Technicals qualifications, we wanted to let you know we have now published the results awarded for 2018/19 Level 2 and 3 Cambridge Technicals (2016 suite). This information is helpful in allowing you to compare your centre achievements alongside national outcomes.

To browse to the document, log in to Interchange, click on 'Resources and materials>Past papers and mark schemes' in the left-hand menu and select 'Cambridge Technicals (2016) Results Awarded 2018/2019' from the drop down list.

ExamBuilder

Remember to keep your eye on ExamBuilder as we continue to update the bank of questions post exam series in line with our past paper policy. Therefore, you can be assured that new assessment material will continually be fed into ExamBuilder on an annual basis.

Online post series external feedback

Keep an eye out for updates on our post series feedback on Exams for Cambridge Technicals Webinars available in the autumn term.

Paper Unit 2 series overview

Historically candidates do not sit a paper that contains more than one science discipline at Level 3. However, it is clear that most Centres are familiar with the style of paper and in general candidates' performance is improving. Most candidates seem prepared for this style of paper.

There is a lot of application and understanding of contexts that some candidates may have struggled with. Centres are encouraged to use sample papers and any previously sat live papers available with the candidates in order to give them practice at the style of paper and the questions within.

Some areas were answered well. Candidates showed good knowledge of safe working practice ,use of aseptic techniques and flame tests. It is important that they give responses specific to the questions and not just generic safe working practices. They were able to carry out calculations related to titrations and give responses to specified number of decimal places. They did not do as well on questions about chemical tests or analysing DNA.

Marks were often lost due to the candidates not reading the question carefully, e.g. not giving a response to the correct number of significant figures or describing the results of a procedure rather than the procedure itself.

This is a techniques paper and so it is the techniques they need to know how to describe. Candidates who have had the opportunity to carry out the techniques are much more able to answer the questions successfully.

Question 1 (a)

1 Alex is a technician working in a college chemistry department.

(a) The chemicals used in the laboratory are labelled with warning symbols to identify the hazards.

Identify the meaning of each hazard warning symbol below.

Write your answer below each symbol.

.... **[2]**

Most candidates knew the first symbol is a warning for explosives or explosions. The symbol on the right is for a serious health hazard. Many just wrote health hazard which is symbolised by the exclamation mark and so this mark was rarely gained.

Question 1 (b) (i)

(b) **Fig. 1.1** shows some typical glassware used in the college chemistry laboratories.

(i) Draw a line to link each piece of **equipment** to its correct **name**.

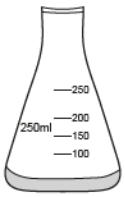
Equipment	Name
	Conical flask
	Graduated pipette
	Measuring cylinder
	Volumetric flask

Fig. 1.1

[3]

Most candidates were able to identify all four pieces of glassware. There was some confusion between the two flasks.

Question 1 (b) (ii)

(ii) Suggest **one** potential hazard shared by all the pieces of equipment in **Fig. 1.1**.

.....**[1]**

Many candidates did not read the question carefully and thought this was about chemicals that might be in the equipment. No marks were given for describing spills or dangerous contents. They needed to give the possible hazard, which is broken glassware so there was also no mark for the risk of cuts. Candidates did not lose marks if they gave the correct hazard and then stated they might cause cuts.

Question 1 (c) (i)

(c) One of the college chemistry teachers is planning a class practical to investigate the oxidation of ethanol.

Fig. 1.2 shows part of the instruction sheet for the practical.

Chemicals required

Ethanol: HIGHLY FLAMMABLE

Acidified sodium dichromate solution: VERY TOXIC, CORROSIVE, OXIDISING

Method

1. Place exactly 3 cm^3 of acidified sodium dichromate solution in a boiling tube.
2. Use a teat pipette to add 5 – 7 drops of ethanol, with shaking.
3. Cool the mixture in the tube under a tap and note the smell.
4. When the reaction has subsided, warm the mixture gently, and again note the smell.

Fig. 1.2

(i) Safe storage of chemicals is an essential part of Health and Safety regulations.

Describe how Alex should store ethanol safely.

.....**[1]**

Very few candidates understood that a specific type of flameproof metal cabinet is needed. Many stated glass container with lid. This question was not well answered.

Question 1 (c) (iv)

(iv) Explain your answer to **(c)(iii)**.

.....

.....**[1]**

If candidates got 1(c)(iii) right, they often still got 1(c)(iv) wrong. Many wrote that a measuring cylinder is very accurate. They had not read and interpreted the word 'approximately' correctly in the question rubric.

Question 1 (c) (v)

(v) All the students wear lab coats and safety glasses.

State **two** further precautions that the students should take to ensure that the practical work is carried out safely.

Explain your answers.

1.....

.....

2.....

.....

[2]

For 2 marks, candidates had to give two risks and the appropriate precautions. Many stated risks but did not give precautions. Many described lab rules such as tie back hair or move stools. This showed they did not understand the specific risks of the experiment that they needed to describe.

Question 1 (c) (vii)

(vii) In step 4 of the practical instructions in **Fig. 1.2** students are told to 'warm the mixture gently'.

Describe how the students should carry out **step 4** safely.

.....

.....**[2]**

Some candidates knew they should warm the mixture in a water bath. Most other candidates had missed the point that the mixture was flammable. This meant many described using a Bunsen burner or a flame and so did not get full marks.

Question 2 (a)

2 Mia works in a laboratory specialising in analysing DNA.

She has been asked to prepare some agarose gel for use in gel electrophoresis.

(a) Mia plans to make 70 cm^3 of a 1.25 % (W/V) agarose solution.

Calculate the mass of agarose she will need to make 70 cm^3 of a 1.25 % (W/V) agarose solution.

Give your answer to **2** significant figures.

Mass of agarose ..... g **[1]**

Many candidates struggled with this question. Many did not divide by 100 and so gave a response of 88. Others did not read the question carefully and so did not give a response to 2 significant figures.

Question 2 (c) (ii)

(ii) Outline how gel electrophoresis of DNA is set up.

You may draw a labelled diagram to support your answer.

.....

.....

.....

.....

.....

.....

.....

.....**[4]**

Only a few candidates got more than a couple of marks here. If they drew a diagram, it had to be clearly labelled in order to gain marks. In some cases, some candidates were able to gain 4 marks from their labelled diagram. Many knew the DNA sat in wells for a mark. Many then went on to describe what you would see rather than the process of setting up the electrophoresis. This did not gain marks. It is important that candidates read the question carefully. Many struggled to describe that a current is applied.

Question 2 (e)

(e) Mia suggests some changes to the electrophoresis set-up.

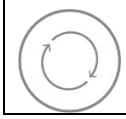
These changes will have an effect on the outcome of the electrophoresis.

Draw a line to connect the **change** to the correct **effect**.

Change	Effect
Increase the potential difference of the power supply.	No separation of DNA fragments.
Use alternating current instead of direct current.	Better separation of small fragments of DNA, poorer separation of larger fragments.
Use a non-mutagenic dye to visualise the DNA.	Reduces the risk associated with gel electrophoresis.
Use a higher percentage of agarose in the gel.	Reduces the time it takes to separate the DNA fragments.

[4]

This question was not well answered. This showed a misunderstanding of the process.

	**AfL**	When studying procedures, it would be useful to discuss each step/piece of equipment and its purpose.

Question 3 (a) (ii)

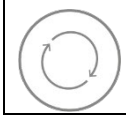
(ii) Which indicator can be used for a weak acid-strong base titration?

Tick (✓) **one** box.

Bromothymol blue	☐
Litmus	☐
Methyl orange	☐
Phenolphthalein	☐

[1]

Very few candidates knew the correct indicators.

	**AfL**	It is important that candidates carry out titrations with a range of different acids and bases and relevant indicators.

Question 3 (b) (i)

(b) (i) State the colour of bromothymol blue in acidic conditions.

.....**[1]**

Many candidates tried to give a colour change, often incorrectly. This showed that they had not read the question correctly. If it was clear that they knew the colour was yellow in acidic conditions, they could still gain the mark.

Question 3 (b) (ii)

(ii) Suggest why universal indicator is not a suitable indicator for an acid-base titration.

.....

.....**[2]**

Candidates struggled to explain this clearly. They were not be given marks for vague responses. Very few were able to explain that there was not a definitive end point.

Question 3 (c) (i)

(c) Anhydrous sodium carbonate has the formula Na_2CO_3.

(i) Use the Periodic Table to calculate the relative formula mass (Mr) of sodium carbonate.

Relative formula mass = ... g/mol **[1]**

Candidates that did not gain marks on this question usually did so because they did not use the mass numbers of the elements. Some used a mixture of atomic number and mass number.

Question 3 (c) (ii)

(ii) Calculate the mass of sodium carbonate required to make 250.0 cm^3 of a 0.0600 mol dm^{-3} standard solution.

Mass of sodium carbonate = ... g **[3]**

Candidates that showed their working picked up marks even if they final response was incorrect. Many did not convert the 250.00 cm^3. Others managed to carry out the conversion correctly and multiply by 0.06 but then did not multiply this response by 106. They still gained 2 marks. This was because they showed their working.

Question 3 (d) (i)

(d) James is a science student.

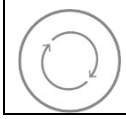
He uses the standard sodium carbonate solution to find the concentration of some hydrochloric acid, $HCl(aq)$.

He titrates the 0.060 mol dm^{-3} sodium carbonate solution against 10.0 cm^3 of the hydrochloric acid.

(i) Give the name of the apparatus used to measure the 10.0 cm^3 of hydrochloric acid.

.....**[1]**

Some candidates gave pipette as a response here. However, they did not state it was a graduated pipette and so did not gain the mark.

	**AfL**	It is important that candidates use correct and full terminology when naming or describing equipment or techniques.

Question 3 (d) (ii)

Table 3.1 shows the results of the titration

	Titration 1	**Titration 2**	**Titration 3**
Final reading (cm^3)	32.80	31.45	31.50
Initial reading (cm^3)	1.10	0.10	0.05
Titre (cm^3)	31.70	31.35	.....

Table 3.1

(ii) Calculate the titre for **Titration 3** and write your answer in **Table 3.1**.

[1]

Most candidates answered this correctly.

Question 3 (d) (iii)

(iii) Calculate the mean titre of 0.060 mol dm^{-3} Na_2CO_3 that James should use for analysing his results.

Mean titre = ... cm^3 **[2]**

Many candidates did not realise that they should only calculate the mean of the concordant results. They added all three titres and divided by 3 to gain the averaging mark but not the second mark for understanding the science.

Question 3 (d) (iv)

(iv) Calculate the number of moles of sodium carbonate used in the titration.

Use the equation: number of moles = $\frac{\text{concentration (mol dm}^{-3}\text{) x mean titre (cm}^3\text{)}}{1000}$

Number of moles of sodium carbonate ..... mol **[1]**

Candidates were able to access the mark here even if they had calculated the mean titre incorrectly. Most were able to substitute the figures correctly and carry out the calculation to gain the mark.

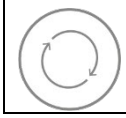
Question 3 (d) (v)

(v) In the reaction between sodium carbonate and hydrochloric acid, **1 mole** of Na_2CO_3 reacts with **2 moles** of HC*l*.

Use the reacting ratio to calculate the number of moles of HC*l* in 10.0 cm^3 of the hydrochloric acid.

Number of moles of HC*l* = ... mol **[1]**

Most candidates knew they had to carry out a calculation involving their answer to 3(d)(iv) and the 2 moles. Unfortunately, many divided by 2 instead of multiplying.

	**AfL**	Practice of these kind of calculations can help candidates gain marks in the exam.

Question 3 (d) (vi)

(vi) Calculate the concentration, in mol dm^{-3}, of the hydrochloric acid.

Give your answer to **3** significant figures.

Concentration of HC*l* = ... mol dm^{-3} **[2]**

Most candidates gave their response to 3 significant figures. This showed they were reading the question which is excellent exam technique. In general, this question was well answered and they understood how to carry out the conversion.

Question 4 (a)

4 Sundip is studying microscopy.

Her biology teacher asks her to investigate the different features of microscopes.

(a) Sundip first compares light and electron microscopes.

Some of the advantages and disadvantages of light and electron microscopy are shown in **Table 4.1**.

Put a tick (✓) in the correct column of **Table 4.1** to show if the advantage or disadvantage applies to a light microscope or an electron microscope.

Advantages or disadvantages	Light microscope	Electron microscope
Cheaper equipment cost		
Highest magnification is up to x 2000		
More skill required to prepare samples		
Produces colour images		
Smaller equipment size and easier to use		
Can view live specimens		
Image cannot be viewed directly by human eye		

Table 4.1 **[7]**

Question 4 (b)

(b) Sundip starts to consider different types of electron microscope in more detail.

Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) have different uses. These are shown in **Table 4.2**.

Put a tick (✓) in the correct column for each use.

Use	SEM	TEM
Viewing below-surface features		
Forming images from reflected electrons		
Showing the internal composition of a structure		
Showing the overall form or shape of a structure		

Table 4.2 **[4]**

In general, these questions were very well answered. Candidates who have had experience of using or comparing different types of microscope showed good knowledge and gained most marks.

Question 4 (c) (i)

(c) Sundip is shown an image produced by an electron microscope. This type of image is called an electron micrograph.

Fig. 4.1 shows an electron micrograph of a virus.

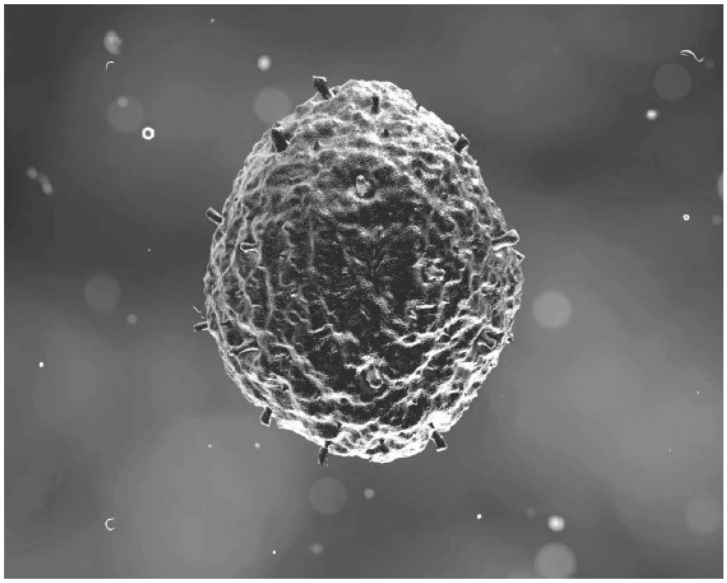


Fig. 4.1

(i) Use a ruler to measure the diameter of the image of the virus in **Fig. 4.1** at the widest part, to the nearest mm.

This is called the image diameter.

Widest diameter of virus (image diameter) = ... mm **[1]**

Many candidates did not understand that the widest part of the virus was the vertical measurement. They gave the horizontal width. This shows a lack of understanding of what Fig 4.1 represents.

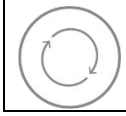
Question 4 (c) (ii)

(ii) The actual diameter of the virus is 200 nanometres (nm).

Convert this value into millimetres (mm).

Actual diameter of virus = ... mm **[1]**

Candidates struggled with this conversion.

	**AfL**	It is important to give candidates opportunity to work with a range of different size measurements and convert between them.

Question 4 (c) (iii)

(iii) Calculate the magnification of the electron micrograph.

Use the formula: magnification = measured size ÷ actual size

Show your working.

Magnification = x …….. **[1]**

Most candidates were able to substitute correctly and gain this mark. They were not penalised if they used an incorrect figure from 4(c)(ii).

Question 5 (a) (i)

5 (a) Kai is a laboratory technician. He carries out tests on various chemical samples.

(i) Kai often uses flame tests to identify cations in unknown samples.

He has three bottles, each containing a white solid. One is sodium chloride, another is lithium chloride and the other is barium chloride.

He uses a flame test to identify the cation in each sample.

State the flame colour for each of the white solids in **Table 5.1**.

White solid	Flame colour
Lithium chloride	
Barium chloride	
Sodium chloride	

Table 5.1 **[3]**

The mark scheme uses the specific colours as listed by the Royal Society of Chemistry. Many students gave incorrect colours. Crimson or crimson red is the only colours allowed for Lithium, green or pale green for Barium, and yellow or orange for Sodium.

Question 5 (a) (ii)

(ii) Describe how a flame test is carried out.

.....

.....

.....

.....

.....

.....**[3]**

Candidates that have carried out this test were able to access full marks. Some did not read the question and tried to describe the results they would see. This did not gain any marks. It was clear that some candidates had not seen or carried out this test as they were unsure how to answer the question. For those who had seen or carried it out, they mostly lost a mark for not making it clear that the flame should be blue or roaring. If they described using a splint, they could still gain full marks for making it clear that a new splint was used each time, for it being dipped in the substance and for a blue flame.

Question 5 (b)

(b) Cations can also be identified using precipitation reactions with aqueous sodium hydroxide.

Draw a line to connect each **cation** to the correct **colour of precipitate with sodium hydroxide**.

Cation	Colour of precipitate with sodium hydroxide
Iron (III) (Fe^{3+})	White
Iron (II) (Fe^{2+})	Light blue
Copper (II) (Cu^{2+})	Pale green
Aluminium (Al^{3+})	Orange-brown

[4]

Again, candidates who had seen or carried out these tests did well here.

Question 5 (c) (i)

(c) Kai also carries out tests using ion chromatography to determine the concentration of caffeine in energy drinks.

The presence of caffeine is shown as a peak in the chromatogram, and the peak area is a measure of its concentration.

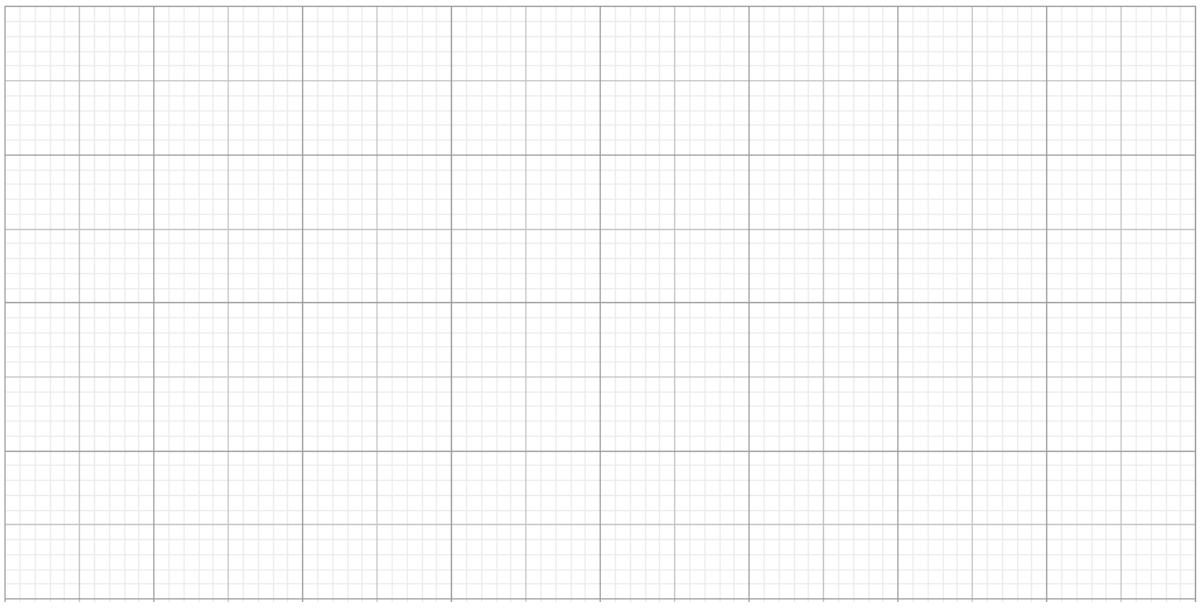
Kai constructs a calibration graph using known concentrations of caffeine.

Table 5.2 shows the relative peak areas of known concentrations of caffeine.

Concentration of Caffeine (mg dm^{-3})	Relative peak area
10.0	35
25.0	70
50.0	140
100.0	280
150.0	420

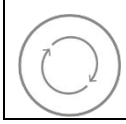
Table 5.2

(i) Plot a graph of the calibration data in **Table 5.2**.



[5]

There were some very good graphs seen. Some candidates had the axes the wrong way around and so did not gain a mark for the axes. Several transferred the numbers in the table directly to the axes and so did not gain the scale mark. This also made it difficult to plot correctly or draw a correct line of best fit.

	**AfL**	Practising plotting graphs will help candidates gain several marks.

Question 5 (c) (ii)

(ii) A sample of an energy drink has a caffeine peak with a relative peak area of 340.

Use the calibration graph you have drawn to determine the concentration of caffeine in the energy drink.

Show on your graph how you obtained your answer.

Concentration of caffeine drink = …….……. mg dm^{-3} **[2]**

Candidates had to show their working on the graph to gain full marks here. This meant that even if they gave an incorrect response, many still gained a mark.

Question 6 (a)

6 Aseptic techniques are an essential feature of biology laboratories.

(a) Different scientific equipment is sterilised in different ways.

Draw a line to connect each type of **equipment and/or material** to the correct **sterilisation method**.

Equipment and/or material	Sterilisation method
Many flasks of bacterial growth medium	Autoclaving
Antibiotic solutions	Dry heat
Inside of controlled air flow cabinets	Filtering
Plastics for medical applications	Gamma irradiation
Glass graduated pipettes	Spray with disinfectant

[5]

Many candidates struggled with this. It is important that candidates have experience of this sort of lab work. This would have helped them with this question.

Question 6 (b)

(b) **Fig. 6.1** shows bacterial colonies growing on an agar plate after bacteria were streaked on to the plate.

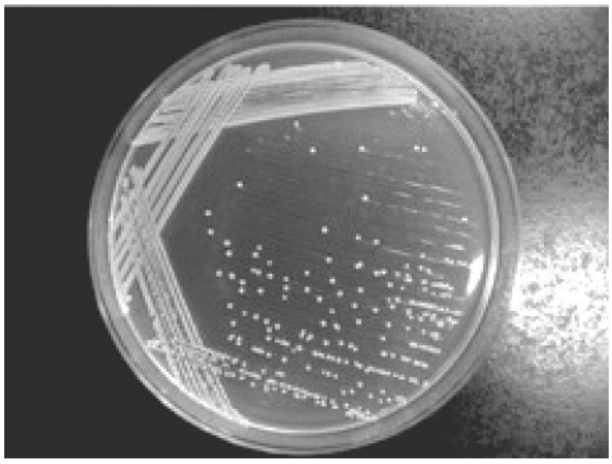


Fig. 6.1

Explain how bacteria can be streaked onto a plate to obtain individual colonies.

You may draw a labelled diagram to support your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....**[6]**

This was well answered in general. Candidates need to take care not to just repeat information in the question or draw out a diagram of the picture as these did not gain marks. A good response included techniques to sterilise the loop and the sample bottle as well as how the streaks were placed on the agar.

Question 6 (c)

(c) Suggest why it is important to obtain single colonies on the plate.

.....

.....**[1]**

Candidates did not understand that this was about having identical cells. So, saying same type was not sufficient for the mark. Many talked about contamination which also did not gain the mark.

Question 6 (d) (i)

(d) Teams of science technicians often share tasks in biology laboratories. One of the technicians streaked a plate of bacteria obtained from a pure culture. However, she did not use the correct aseptic technique.

Fig. 6.2 shows a magnified view of the plate.

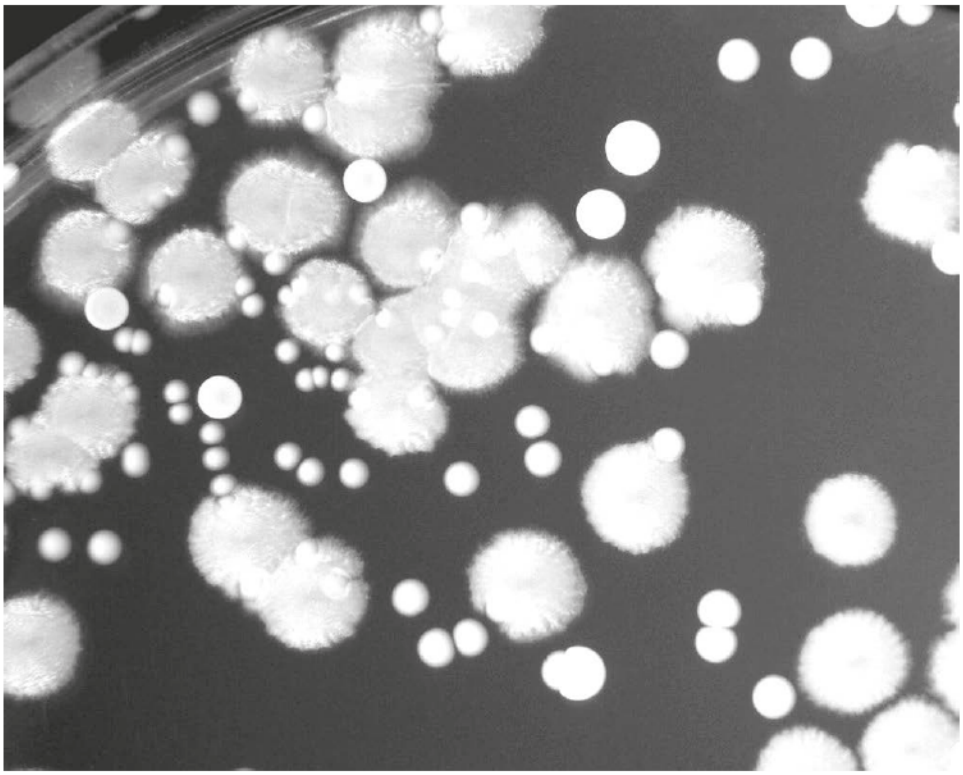


Fig. 6.2

(i) State how you can tell that the plate is contaminated.

.....

.....**[1]**

The best responses described what the candidates could see. Stating there are lots of bacteria/cultures was not sufficient. They needed to be clear that the cultures had different shapes and sizes and so were different.

Question 6 (d) (ii)

(ii) Estimate the number of different microorganisms present on the plate.

.....**[1]**

Some candidates tried to count all the cultures and so gave numbers of 70 or above. This showed they do not understand how to interpret a culture.

Question 6 (d) (iii)

(iii) Explain why the contaminated plate should be autoclaved as soon as is possible.

.....

.....**[1]**

Most candidates were able to gain a mark for the idea of pathogens or contamination.

Copyright Information

Supporting you

For further details of this qualification please visit the subject webpage.

Review of results

If any of your students' results are not as expected, you may wish to consider one of our review of results services. For full information about the options available visit the OCR website. If university places are at stake you may wish to consider priority service 2 reviews of marking which have an earlier deadline to ensure your reviews are processed in time for university applications.

CPD Training

Attend one of our popular CPD courses to hear exam feedback directly from a senior assessor or drop in to an online Q&A session.

Please find details for all our courses on the relevant subject page on our website.

www.ocr.org.uk

Did you know?

OCR Resources: *the small print*

OCR's resources are provided to support the delivery of OCR qualifications, but in no way constitute an endorsed teaching method that is required by OCR. Whilst every effort is made to ensure the accuracy of the content, OCR cannot be held responsible for any errors or omissions within these resources. We update our resources on a regular basis, so please check the OCR website to ensure you have the most up to date version.

This resource may be freely copied and distributed, as long as the OCR logo and this small print remain intact and OCR is acknowledged as the originator of this work.

Our documents are updated over time. Whilst every effort is made to check all documents, there may be contradictions between published support and the specification, therefore please use the information on the latest specification at all times. Where changes are made to specifications these will be indicated within the document, there will be a new version number indicated, and a summary of the changes. If you do notice a discrepancy between the specification and a resource please contact us at: resources.feedback@ocr.org.uk.

Whether you already offer OCR qualifications, are new to OCR, or are considering switching from your current provider/awarding organisation, you can request more information by completing the Expression of Interest form which can be found here: www.ocr.org.uk/expression-of-interest

Please get in touch if you want to discuss the accessibility of resources we offer to support delivery of our qualifications: resources.feedback@ocr.org.uk

Looking for a resource?

There is now a quick and easy search tool to help find **free** resources for your qualification:

www.ocr.org.uk/i-want-to/find-resources/

Need to get in touch?

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our **Customer Support Centre**.

Vocational qualifications

Telephone 02476 851509
Facsimile 02476 851633
Email vocational.qualifications@ocr.org.uk

www.ocr.org.uk

Cambridge Assessment

CERTIFIED ISO 9001 UKAS MANAGEMENT SYSTEMS 001